

**External Peer Review by the Center for Independent Experts**

**Review of Draft Green Sturgeon Recovery Plan**

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## **Executive Summary**

The Internal Draft Recovery Plan Southern Distinct Population Segment North American Green Sturgeon (DRP) was reviewed for six terms of reference: (1) conformance with NMFS and ESA conservation and recovery standards; (2) match between goals, objectives, criteria and actions; (3) incorporation of best available science; (4) treatment of information gaps in recovery and research actions; (5) evaluation of a habitat model relevant to recovery goals; and (6) guidance on recovery actions to the public, conservationists, managers, regulators and other stakeholders. Recommendations outside these terms of reference were also solicited.

The DRP met most standards set forth by provisions in the NMFS Interim Guidelines and the Endangered Species Act. The plan incorporates the best science available. Indeed, the draft development team is to be commended for its strong scholarship, inclusion of the most recent information, and comprehensive consideration of many direct and indirect threats. An important departure from the standards was the adoption of demographic criteria that reduce risk of further decline and an Endangered Listing rather than those that would lead to delisting. The principal targets of demographic criteria are a minimum adult population census (2500) and the maintenance and/or recovery of reproduction in multiple spawning rivers within the Sacramento River Watershed. Quantitative habitat criteria were not developed due to information gaps and uncertainty. In place of habitat criteria for recovery, a threats ranking exercise was conducted. Progress in habitat criteria are met when threats are ranked lower in a future threats ranking exercise. Priorities, threats, criteria, and actions are presented separately for four habitat units: the Sacramento River Watershed, the San Francisco Bay Delta/Estuary, Coastal Bays and Estuaries, and Nearshore Marine. Action items were presented in highly specific terms for the first two habitat units; presentation of actions outside the California Central Valley remains incomplete.

Milestones were presented as 5-year horizons. The first phase would begin implementation of high priority actions to reverse further decline of the Southern DPS, develop a research plan including a conceptual model, continue monitoring, and develop outreach and funding streams. The following two 5-year phases were adaptive responses to developing research and monitoring capacities. No cost estimates were provided other than broad but justified statements on water use conflicts within California's Central Valley and the large expense and political difficulties in removing impoundments and restoring natural hydrograph functions to the Sacramento and San Joaquin River watersheds.

In evaluating historical and current spawning habitats in the Central Valley Ecosystem, an analysis by Mora et al. (2009) employed a feasible approach that depended on several assumptions, including that green sturgeon incidence data in the reference systems were unbiased, that habitat selection between Southern DPS and Northern DPS was similar, and that a composite (multivariate) habitat variable is informative on habitat selection. The DRP appropriately incorporated this analysis as a starting point in ranking potential spawning rivers rather than ascribing high certainty to study results.

The flow of the plan suffers from a mismatch between the central priority of restoring reproductive function to the Sacramento River Watershed and the threats ranking exercise, which did not support this central priority, and gave highest priority to highly uncertain threats. The central priority also was not well articulated by Recovery Objectives, which were too general to lead to strong criteria statements. Implementation tactics during the first 5- year phase emphasized research needs, rather than strategically laying out a conceptual model for recovery and development of a monitoring program to evaluate interim recovery criteria.

The central recommendation of this review is to employ an adaptive management framework for the central objective implicit in the plan: improving reproductive function in multiple rivers within the Sacramento Watershed. Indeed, NMFS Recovery Planning Guidance urges adaptive management as a principal strategy “when uncertainty exists regarding the threats to the species, the species’ life history, or the effectiveness of various management actions” (NMFS 2006). The current top priority within the DRP is to develop a research plan as an outcome of a future workshop. Without an organizing concept of recovery, the result of such a workshop is highly uncertain and could lead to diffuse priorities related to future research agendas. There is an important opportunity to build on the recent strong period of green sturgeon research and begin a structured program of monitoring, assessment, and research into critical processes that support a general concept of recovery for the Southern DPS. Revisions to the draft DRP are recommended to reinforce the central priority of restoring reproductive function in the Southern DPS through development of a simple conceptual model, which prioritizes monitoring and assessment over research and initiates the cycle of adaptive management (see NMFS 2006; Figure 1: *The Recovery Process*).

A second principal recommendation is to de-emphasize the threats ranking exercise, which while a useful exercise in identifying all potential threats, was subjective, non-repeatable, counterintuitive in results, and detracted from the central interim criteria. The ranking exercise also placed high demands by the plan development team to work through actions pertinent to hundreds of potential threats listed (i.e., Appendix E). Such voluminous threats, criteria, and actions are likely to detract from clear guidance and outreach to managers, regulators, the public and other stakeholders.

Reduction of takes outside the Central Valley habitat units merits additional background and analysis within the DRP with regards to developing criteria specific to commercial and recreational fishery bycatch.

## **Background**

The southern Distinct Population Segment of North American green sturgeon was listed as a threatened species in 2006. In response, a Draft Green Sturgeon Recovery Plan was prepared by the National Marine Fisheries Service Southwest Regional Office for review by the Center for Independent Experts (CIE). Principal elements of Recovery Plans are structured in accordance to standards defined in section 4(f)(1) of the federal Endangered Species Act (ESA) and sections 1.1 and 1.2 of the National Marine Fisheries Service Interim Recovery Planning Guidance (NMFS 2006).

The Internal Draft Recovery Plan Southern Distinct Population Segment North American Green Sturgeon (DRP) was reviewed for six terms of reference: (1) conformance with NMFS and ESA conservation and recovery standards; (2) match between goals, objectives, criteria and actions; (3) incorporation of best available science; (4) treatment of information gaps in recovery and research actions; (5) evaluation of a habitat model relevant to recovery goals; and (6) guidance on recovery actions to the public, conservationists, managers, regulators and other stakeholders. Recommendations outside these terms of reference were also solicited.

Additional background pertaining to implications of the Green Sturgeon Recovery Plan, directions to CIE Reviewers and the Terms of Reference of the peer review are attached to this report in **Appendix 2**.

## **Description of Review Activities**

CIE reviewers conducted desk peer review of the DRP. Relevant to this review, I have expertise specific to sturgeon biology, ecology, demographics, and assessment and have served as an expert reviewer for plans and issues pertaining to shortnose sturgeon, Atlantic sturgeon, pallid sturgeon, and Caspian Sea sturgeon status and recovery.

On 15 October 2012, I was supplied with the DRP, appendices and a supporting document (Mora et al. 2009) by e-mail correspondence from the Green Sturgeon Recovery Coordinated, Dr. David Woodbury. Dr. Woodbury indicated in correspondence at that time that the Recovery Plan was an early draft and had seen limited internal review. In addition electronic access was provided for the Endangered Species Act and the NMFS 2006 Report, “Interim Endangered and Threatened Species Recovery and Planning Guidance Version 1.3.” I also made use of recent scientific literature on green sturgeon. All sources are listed in **Appendix 2** of this report.

My review activities consumed six work days during late October and early November 2012. During that period, I critically analyzed the Draft Recovery Plan, developed a series of findings, and prepared this report in response to the Terms of Reference (see Appendix 2).

## Findings according to Term of Reference

**1. Do the basic elements of the draft recovery plan meet the minimum standards for recovery plans outlined in the NMFS Interim Recovery Guidance and mandates described in section 4(f)(1)(b) of ESA?**

The Draft Recovery Plan (DRP) sufficiently addresses NMFS standards for an Interim Recovery Plan, but deliberately does not provide criteria for ESA delisting, nor were specifics provided on management action priorities or costs associated with sDPS green sturgeon recovery. The consensus of the Green Sturgeon Recovery Team (GSRT) was that insufficient information exists to establish firm demographic criteria and recommend specific management actions for delisting. Rather, the team placed priority on criteria and actions designed to safeguard the sDPS against further decline and a modified listing from Threatened to Endangered Status.

In my view, the interim framework is justified given the state of uncertainty on sDPS demographic status and life history dependencies within the Sacramento River Watershed and San Francisco Bay Delta/Estuary. A principal deficiency in the plan is a conceptual model to frame assessment, scientific, and action priorities. The plan comes close by providing a thorough review of best available science and sound scientific reasoning, leading the GSRT to repeatedly emphasize the goal to sustain/recover multiple spawning rivers within the Sacramento River Watershed (i.e., the Feather and Yuba Rivers). Based upon my review of the literature and the Draft Plan, this priority is well supported. Still, how this principal goal leads to monitoring, science, and actions is vague within the DRP because there is not a strong organizing theme. What is needed is a conceptual model that links current scientific understanding to maintenance and restoration of spawning function to Sacramento Watershed Rivers. The conceptual model can be simple, for instance representing a consensus view of the GSRT, but in my view it is critical to initiate one to begin the cycle of adaptive management and monitoring. Without an adaptive management structure, goals cannot be efficiently linked to assessment, science, actions, and public education; progress towards recovery criteria cannot be easily assessed.

Below I review each NMFS and ESA standard:

From section 1.1 of NMFS (2006):

- Delineate those aspects of the species' biology, life history, and threats that are pertinent to its endangerment and recovery.

The DRP provided a comprehensive review of species biology and life history pertinent to existing threats and recovery potential. The past 15 years has been an incredibly active period for green sturgeon research with surprising new discoveries occurring in just the last several years, including (1) acoustic records and DIDSON counts of spawners above the Red Bluff Diversion Dam, where spawning activity had been uncertain (Brown 2007; Heublein et al. 2009); (2) high connectivity of the sDPS with the lower Columbia River (Lindley et al. 2011); and (3) large aggregations of sDPS in non-natal coastal bays and estuaries (Lindley et al. 2011).

The GSRT has done a commendable job in placing these and other new discoveries into the context of threats and recovery of the sDPS.

- Outline and justify a strategy to achieve recovery.

The narrative of the DRP provided strong justification for improving the status of sDPS green sturgeon through provision of multiple spawning rivers within the Sacramento Watershed. Other themes developed were protection of holding, rearing, and forage habitats and migration corridors within the San Francisco Bay Delta/Estuary, and reduction in takes of juveniles at water diversions and takes of sub-adults and adults through poaching and other human interactions.

- Identify the actions necessary to achieve recovery of the species; and

A series of very specific actions comprised approximately one-third of the DRP (p. 60-87). The list remains incomplete for Strategy Objectives 3 and 4, which focus on threats to coastal bay, estuarine, and nearshore marine phases of the sDPS. Actions were not prioritized or given structure regarding how they will achieve interim goals of improved reproductive status and reduced takes.

- Identify goals and criteria by which to measure the species' achievement of recovery.

Goals and criteria were provided for interim goals of spawner abundance, effective population size, functioning spawning and early rearing habitats, and takes in the DRP.

From Section 4(f)(1)(b) of ESA:

- A description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species.

Action items listed for the Sacramento River Watershed and San Francisco Bay Delta/Estuary (p. 60-84) were quite detailed with regard to siting, environmental context, and principal management/public entities engaged with proposed actions. The list seems quite comprehensive in terms of factors that *may* be of concern for green sturgeon conservation and survival. Management actions for habitat units outside the California Central Valley River ecosystem were not provided.

- Objective, measurable criteria which, when met, would result in a determination...that the species be removed from the list.

Objective criteria were provided for interim goals of improved reproductive status in the Sacramento River Watershed (rather than delisting). Of these, spawning adult abundance and incidence of embryos and larvae were the only measurable criteria included.

- Estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.

Milestones were presented in five-year horizons. The first phase would begin implementation of high priority actions (albeit not specifically prioritized in the DRP), develop a research plan including a conceptual model, continue monitoring, and develop outreach and funding streams. The following two 5-year phases were adaptive responses to developing research and monitoring capacities. No cost estimates are provided other than broad but justified statements on water use conflicts within California's Central Valley and the large expense and political difficulties in removing impoundments and restoring natural hydrograph functions to the Sacramento and San Joaquin River watersheds.

## 2. Is there a logical and consistent flow between the goal, objectives, criteria, and actions?

There was a consistent flow in the narrative relating goals, objectives and criteria but the logic becomes difficult to follow as the report moves through the many threats and management actions nested within life history stages and habitat units. The DRP provided sufficient redundancy for the reader to know that the overall goal was to maintain and improve reproduction in the Sacramento River Watershed but this same priority is not clearly presented in a table designed to show the match between the goal, objectives, criteria and actions (p. 55). I think the issue is that the objectives may be overly broad – rather more specific objectives are needed to efficiently link these to criteria, threats, and actions. I would urge articulation of objectives that are better matched with interim criteria D1-D6 and TA (p. 48-49). Based on the narrative of the DRP and recent literature, these are clearly top priority objectives in the near term.

Less certain objectives, for instance those related to climate change, coastal habitat use, predation by sea mammals, contaminants, etc. merit consideration but these represent moderate to longer term priorities for research and amended recovery plans. In trying to be too inclusive at the start, the DRP over-emphasize research needs and under-emphasizes immediate tactical steps that can be taken to improve the status of the sDPS. As indicated above these tactical steps are well emphasized in the narrative of the DRP in multiple sections, but they are obscured in statements of objectives and actions, and priority and threats rankings.

The priority rankings on p. 59 of the DRP were broad but justifiable in my view. Rank 1: actions that improve demographics of the sDPS and prevent irreversible decline; Rank 2: habitat improvements; Rank 3: all other actions to promote recovery. Later on this same page, the DRP indicates that threats ranked highest by life history stage and habitat unit in Table 1 (Miradi-ranking exercise results) will receive highest action priority. But in contrast with strongly supported recovery themes developed in the narrative, the highest ranked threats in that Table occur outside the Sacramento River Watershed. Indeed half of the highest ranked threats occurred outside the Central Valley Ecosystem, habitat units for which no action items were listed. There is a clear disconnect between the threats ranking exercise and the consensus building that is reflected in the narrative of the DRP. I found results of the threats ranking exercise counter-intuitive and given its strong subjective bias I would urge de-emphasis of this exercise in the report. I found it only detracted from the flow of goals, objectives, criteria, and actions. Similarly the flow diagrams presented in Appendix E were uninformative.



### 3. Does the plan incorporate the best scientific information available?

Yes, the GSRT is to be commended for its strong scholarship, inclusion of the most recent information, and comprehensive consideration of many direct and indirect threats to sDPS status and recovery. This science has become voluminous and complex providing a challenge in attempts to critically synthesize and integrate it. I observed that there was a solid mix of scientific reasoning based upon theory, familiarity with the Central Valley Ecosystem, and general knowledge of sturgeon biology.

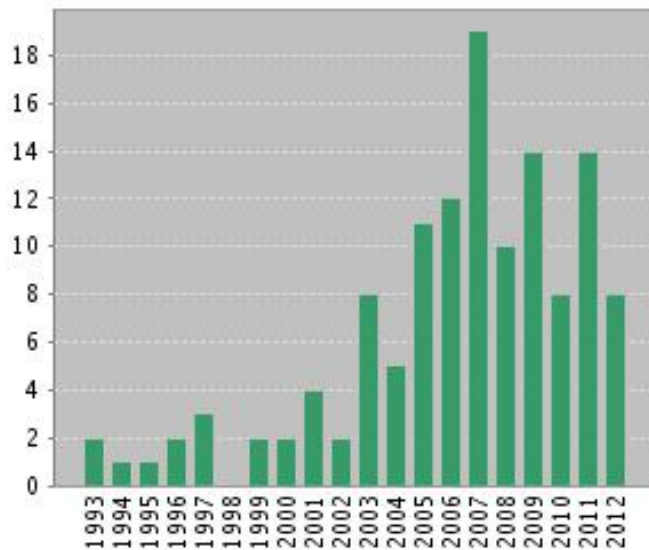


Figure from Web of Science © showing increase in journal-published research on green sturgeon during the past 10 years. Key word="green sturgeon"; n=133 citations; h=20; mean times cited 10/paper.

### 4. Does the plan address data gaps appropriately in relation to the formulation of recovery criteria and research actions (e.g. lack of information on contaminants to develop threats-based recovery criteria)?

The DRP emphasized critical research gaps within the narrative and under RS Objective 5. These include research that supports quantitative criteria development for adult spawning and early life history stage use of spawning/nursery habitat within the Sacramento River Watershed (R1.1.1 to RP1.1.6). Development of a conceptual life history model was also prioritized within these research objectives. Research objectives were also presented for contaminants, water quality, sediments, predation, depth and flow management within the Sacramento River Watershed and San Francisco Bay Delta/Estuary (RP2.1.1-RP2.1.6). The research list was incomplete for habitat units outside of the Central Valley Ecosystem. Still, within the narrative of the DRP and Appendix C, there was quite exhaustive consideration of threats across habitat units, which remain uncertain in their effects requiring extensive research (e.g., investigations on contaminants, non-native species, shoreline development, bay and estuarine habitat degradation in non-natal regions).

The DRP gave strong priority for future research planning but insufficient priority on monitoring green sturgeon status and recovery. A central recommendation was to convene green sturgeon scientists in a workshop format to develop a comprehensive research plan. One could ask that with top green sturgeon scientists on the GSRT, why wasn't a research plan developed here, within this plan. My view is that there are several robust and synoptic treatments on green sturgeon demographics that could have supported not only a conceptual life history model for green sturgeon, but a conceptual model for sDPS recovery as well (Beamesderfer et al. 2007; Heppel 2007; Adams et al. 2007). Having participated in research planning exercises, I expect that without a beginning conceptual model, a comprehensive research plan will generate a long list of research questions that are not adequately prioritized nor efficiently linked to recovery.

With or without a conceptual model and comprehensive research plan, monitoring and assessment are the most critical gaps in my opinion. Monitoring was given priority within the DRP but receives second priority to development of a research plan. In my view, the first order is to determine the population status in the Central Valley River Ecosystem. There are critical new (telemetry, DIDSON, quantitative embryo and larval sampling) and historical observing platforms that need critical support, review, modification, and coordination. I found it reassuring that interim spawning abundance criterion (2500 spawners) was within the range of what would be expected from recent abundance estimates of sub-adults in the San Pablo Bay (~500-8000), and historical salvage takes of juveniles (thousands per year) (Adams et al. 2007), particularly when we bring in expected stage structure (Beamesderfer et al. 2007). Further the recent estimates by DIDSON (p. 28), would indicate a spawning population of c. 1000. I thought that the text within the DRP should have made these connections as well to justify that monitoring is feasible but highlight monitoring gaps and assumptions (e.g. species ratios, sampling efficiencies, use of telemetry in mark-recapture designs), which merit high priority in support of interim objectives. A very useful step is to subject historical monitoring programs to a power analysis to determine whether current sampling designs allow detection of population trends of interest (e.g., a 20% increase in 10 years) (Schapaugh and Tyre 2011). This allows agencies to know what level of investment is needed to support the interim recovery goal of 2500 adults.

The risk in over-emphasizing uncertainty and research is diffuse planning, the epitome of which might be exemplified by NMFS Shortnose Sturgeon Recovery Plan (NMFS 1998), which is essentially a list of research questions guided by a research plan (listed under Recovery Task Summary of that report; p. 89). It contains no quantitative criteria for recovery, no coordinated plan of monitoring, and no strong conceptual underpinning for recovery actions. Simply put, the plan cannot be implemented. There is much less risk of inefficient planning and recovery actions for sDPS green sturgeon because spawning is concentrated in a single system rather than along an entire US coast as occurs for shortnose sturgeon. Still, the Shortnose Sturgeon Recovery Plan should caution future recovery planning efforts on the risks of over-emphasizing scientific gaps and uncertainty at the expense of taking concrete steps towards improved monitoring and adaptive management.

5. Does the data provided by Mora et al. 2009 provide NMFS the best means for evaluating current and future habitat potential and the development of criteria to restore historical green sturgeon habitat within California's Central Valley.

In my judgment the Mora et al. 2009 approach is feasible and analytically robust and supports the view that important spawning habitat contraction has occurred in the Sacramento-San Joaquin system. Still, some caution should be exercised – application of nDPS habitat incidence to the Central Valley Ecosystem likely presents a liberal evaluation of potential habitat. On a conceptual basis the approach has merit: for instance the analysis, if valid, might support the views that (1) the Sacramento, Feather, Yuba, and San Joaquin Rivers function as adult migration corridors as they do in the Klamath-Trinity and Rogue Rivers and (2) based upon habitat affinities, spawning adults would be expected to utilize reaches above existing dams such as Shasta and Oroville. These would seem useful starting points in a recovery plan. In general however, I find greater support for using direct observations (e.g., Heublein et al. 2009; DIDSON observations reported in the DRP) than the Mora et al. 2009 habitat model in making conservation decisions about prioritizing restoration of spawning reaches.

Habitat models merit strong emphasis for rare species like sturgeons to identify potential habitats due to the inability to empirically evaluate all habitats. This is particularly true in prioritizing habitat restoration, where current and historical habitat functions are unknown. Here habitat models can provide a functional or statistical basis for conservation priorities. The approach taken by Mora et al. is clearly statistical, relying on a multivariate statistic – Mahalanobis distance (D) – that describes velocity, discharge, temperature, and gradient affinities for adult green sturgeon in nDPS spawning rivers. The attraction of this approach is that habitat variables are ordinated so that they are appropriately weighted by their relative influence. The distance statistic has additive attributes that can be used to discriminate sites that depart from D, which represents the highest incidences of green sturgeon. The approach is feasibly applied to instances where only incidence data are available (Clark et al. 1993). There are several strong assumptions:

1. Highest incidence and the associated mean D represents optimal habitat conditions (Mora et al. 2009). It is important to recognize that that incidence is the lowest ranked data applied to habitat value. Of particular concern here is the incidence data used for the Rogue, Klamath and Trinity Rivers. These data were dominated by telemetry studies and used repeated measures of incidence from the same individuals and the same remotely deployed receivers. There is a strong likelihood of bias in using incidence data that does not adequately adjust for covariance and bias in sampling design. Figure 2 in Mora et al. 2009 provides a compelling depiction of potential habitat selection, but judging by air temperature, it would seem that *available habitat* includes all seasons. Thus, this figure may be depicting seasonal incidence in spawning rivers rather than spatial incidence within rivers. Again this bears on how incidence data is taken to represent habitat selection.
2. Habitat affinities are similar between nDPS and sDPS adults. Given high rates of mixing in coastal regions by these two DPSs, and similarity in spawning phenology, this assumption seems supported. On the other hand nDPS adults spawn in relatively small coastal river systems, which both historically and in recent times are distinct in ecosystem

attributes from large valley river systems such as the Sacramento-San Joaquin. For instance, Pacific salmon habitat affinities, spawning phenologies and life history types vary considerably between these classes of river systems. For the current habitat model, if gradient has a strong influence on D for coastal (high gradient) rivers, the statistic could over-emphasize the value of low gradient habitats in the Sacramento-San Joaquin system. Related to this point is that I judged the calibration fit to be fairly poor between the Sacramento River and nDPS incidence data (Mora et al. 2009; Figure 3). Indeed the cumulative frequency diagram for the Sacramento River indicates a fairly uniform distribution of incidence v. habitat variables suggesting less selection of these variables.

3. A variety of habitat variables can lead to the same D statistic (Clark et al. 1993). This is a common problem with multivariate Habitat Suitability Models. Here the advantage is that individual habitat variables are appropriately weighted (rather than say arbitrarily assigning equal weight as many models do), but there remains no easy way to disentangle the relative influence of habitat variables, which could be important in assigning priority to habitat restoration actions.

In summary, I think the approach is useful in casting a very broad envelope on what parts of the Central Valley Ecosystem might be surveyed for adult incidence or support re-introduction trials as listed in Phase 3 of the Recovery Plan Implementation scheme (DRP; p. 13). I believe that assumptions are currently too limiting to apply a habitat model based on available incidence data from the nDPS. The authors recognize some of these limitations and call for increased effort to develop improved functional relationships between incidence and habitat variables – those likely to be of importance to adults and other life history stages.

**6. Does the plan provide clear guidance for the public, conservationists, managers, regulators, and others to act in a relevant manner over the next several decades to facilitate recovery of sDPS green sturgeon?**

The DRP provided quite specific action recommendations for the Sacramento River Watershed and San Francisco Bay Delta/Estuary Habitat Units. Appendix F specified relevant management and other entities that will need to be engaged to successfully implement Recovery Strategy Objectives 1 and 2. Many of these were quite detailed on actions required at dams, impoundments, pumps, and diversions; a list of actions that is ambitious and highly relevant to the overall strategy of restoring spawning function to the sDPS, which will keep the public, conservationists, managers, and regulators engaged in relevant recovery actions in the coming decades. As mentioned above, Recovery Strategy Objectives 3 and 4 were not yet populated with specific actions or guidance narratives but in agreement with the DRP Narrative (as well as Appendix C), these habitat units are in general lower priority than habitat units in the Central River Valley Ecosystem. I thought Research Objectives 5 and 6 needed re-structuring and better specification to provide guidance to future planning activities pertinent to monitoring, assessment and research.

## 7. Recommendations for improvements?

Overall, I would recommend adoption of an adaptive management framework for this recovery plan. This would not necessarily require substantial redrafting of narratives or principal priorities implicit in the report but would give them an important structuring framework that efficiently links best available science to objectives, criteria, management action, and monitoring. Related to this, the overall objectives were too general and need increased specification to improve flow to criteria and actions.

The current flow of the report depended on a threats assessment exercise that I did not find particularly successful or useful in depicting consensus views that I drew from narratives in the DRP and Appendix C. There were far too many discrepancies to heavily weight priority actions on the threats ranking exercise. These included lack of high risk ranks for the Sacramento River Watershed and San Francisco Bay Delta/Estuary in comparison to other habitat units, when clearly the DRP emphasizes impoundments, diversions, flows, and restoration of spawning river function in its conceptual development and Restoration Strategy Objectives (narrative and Appendices C and F). Certain threats rated very high or high in Coastal Bays and Estuaries and Marine habitat units (climate change, ocean acidification, water quality, and non-native species), which seem of speculative or secondary importance in comparison to threats that directly bear on reproduction or early survival. Pertinent here is that very little indicates that sub-adult/adult survival is low; indeed a recent estimate of mortality for these size-classes based on telemetry (Lindley et al. 2011) places total mortality at 84%, right at what's expected for natural mortality based upon life history considerations for this species. Heppell's (2007) conclusion is important here, "Although adult survival rates may have highest elasticities, the natural survival rates of adults might already be so high that no management alternative is likely to improve it." Alternatively, the highest potential for recovery (rather than harm) is during the first year of life directing efforts towards actions that affect reproduction and early survival rates (Gross et al. 2002). The discoveries of non-natal bay and estuarine habitat use are important to consider, but I thought that the threats exercise likely over-emphasized these in terms of habitat threats.

In threats related to takes, I think newfound mixing between the two green sturgeon DPSs and mixing of green sturgeon with white sturgeon merited additional priority and guidance in criteria and actions. These considerations are given emphasis in the narrative of the DRP and Appendix C, but because threat objectives were not included under Recovery Strategy Objectives 3 and 4, guidance is currently lacking. Bycatch and other coastal takes of Atlantic sturgeon (the other marine-dependent North American sturgeon) is currently the greatest threat to their recovery (ASMFC 2007; NMFS 2012). I would have liked to have seen a fuller treatment of threats related to bycatch incidence and mortality and tribal fisheries in the DRP (Adams et al. 2007 contains useful information here, but see also Stein et al. 2004 and ASMFC 2007 for assessment of bycatch losses in Atlantic sturgeon).

There are over 30 actions listed for Recovery Strategy Objective 2 that deal with restoration of wetland/marsh/near shore habitats, but I could find no justification for a direct link between these littoral habitats and sturgeon production/restoration. Indirect links are possible but these are speculative. Indeed text in Appendix C acknowledges that green sturgeon use open water rather than shoreline littoral habitats, stating that threat severity should be low. I think the strong

emphasis on wetland and shoreline protection implied by the numerous action items in the DRP, may be an over-reach without strong evidence of direct or indirect effects. Here again, development of a conceptual model would be helpful to guide future research and recovery objectives/actions. For Missouri River pallid sturgeon for instance, the link is related to improved forage export from littoral zone areas to open water areas where juvenile and sub-adult sturgeon feed<sup>1</sup>. This function is uncertain, but is being tested in an adaptive management framework (concept → habitat modification → monitoring → assessment).

Just a general question related to the principal objective of establishing spawning outside of upper Sacramento River: Is it believed that spawning in Feather/Yuba Rivers represent discrete segments of the sDPS? For instance that natal homing/spawning fidelity would occur in these alternate spawning rivers?

#### Specific Comments:

P. 9. I would urge a stronger statement of interim objectives aimed at restoring reproductive function in the Sacramento River Watershed from the start. The broad objectives are important but are in fact principles rather than objectives, which can lead towards an implementation strategy. As indicated above, I would urge reprioritizing general action items to emphasize implementation of monitoring and an adaptive management framework over research.

P. 10. Is it really possible to develop criteria around effective population size? My albeit naïve view is that this approach, while attempted for sturgeons, has not been too successful given high levels of uncertainty and problems with underlying Hardy-Weinberg assumptions. Perhaps some discussion of these uncertainties should be attached to this criterion.

Why were 8 of 10 years chosen for incidence of larvae and juveniles? No justification for this specific ratio was given in the DRP.

P. 12. There was very nice conceptual language here justifying maintenance/recovery of reproductive function to multiple spawning rivers, which did not see due emphasis in threat ranking, priority statements, and Recovery Strategy Objectives.

P. 18. The discovery of spawning in Feather River is quite good news for recovery of the sDPS. I think here and for the unpublished DIDSON observations of spawning adults in the upper Sacramento River (p. 28), additional details would be helpful as this research has not yet been published.

P. 19. In a recent paper based upon quite a large database of telemetered green sturgeon, Lindley et al. (2012) suggested that green sturgeon migrations might be socially transmitted. If so, this would suggest some degree of straying would occur between the DPSs, even though telemetry records indicate no sDPS fish in freshwater sections of rivers north of the Central Valley. Some

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<sup>1</sup> [http://www.moriverrecovery.org/mrrp/f?p=136:155:1410774312615001::NO::PIS\\_ID:45](http://www.moriverrecovery.org/mrrp/f?p=136:155:1410774312615001::NO::PIS_ID:45)

additional discussion on genetic evidence and telemetry evidence for and against straying between the two DPSs would be helpful.

P. 26. There was useful background and quantitative information given on historical data sets relevant for monitoring green sturgeon abundance for several life history stages. I thought there was a missed opportunity here to critically review these data sets and propose specific actions to prioritize their development for use in interim monitoring. There seem to be critical unresolved issues related to estimating ratios of green to white sturgeon in San Pablo Bay and estimating sampling rates of larvae and juveniles at various traps, dams, pumping stations, and fish salvaging operations. These should receive top research priorities along with promising new monitoring approaches (DIDSON).

P. 28. Here is a primary threat statement again that does not jibe with the threats ranking exercise and does not receive due emphasis in the overall plan:

“The primary threat to sDPS green sturgeon at the time of listing was determined to be the loss and degradation of habitat in California’s Central Valley, with a resulting concentration of the spawning population into a single location of the mainstem Sacramento River and overutilization in the form of fisheries conducted in the northwest coastal bays and estuaries.”

P. 32. Altered Water Flow section. In literature I read, there was the suggestion that the current altered hydrograph and temperature control resulting from Shasta Dam operations was favorable to early green sturgeon incubation and survival because it maintained a favorable thermal regime for many months. Thus the Shasta Dam operations are apparently critical for reproduction by the sDPS. I may have misunderstood this, but how Shasta Dam plays into successful reproduction and early survival merits additional articulation and possible criteria and action items.

P. 33. Altered Sediment section. At least one paper has suggested (for white sturgeon) that seasonal changes in flow are critical to insure clean and scoured hard substrate for spawning (Coutant 2004). I think this concept merits consideration here. Also sediment can adhere to eggs making them less adhesive and potentially influencing fertilization success and embryo survival.

P. 34. Loss of Wetland Function section. It would be helpful here to include information that links green sturgeon to wetlands. Does any evidence place them in littoral habitats; any evidence for forage/indirect interactions with wetlands?

P. 35. Discard mortality – 11-30% seems high; the Suuronen and Erickson reference is fairly generic, particularly considering that much lower values have been estimated directly for green and white sturgeon ~3-5% (presented on p. 36 of DRP).

P. 36. The material related to bycatch in commercial fisheries does not receive sufficient treatment in my opinion. Given the high number of takes (1200-1500 sDPS sturgeons) additional documentation/analysis of bycatch and bycatch mortality is strongly indicated as even small levels of mortality could retard recovery (ASMFC 2007; NMFS 2012). Is there no observer coverage to support an analysis? Sturgeons are likely to be robust against trawl fishing, but

bycatch mortality rates can be quite high in gill nets. More information on which gill net fisheries encounter sturgeon and their observed bycatch is warranted.

P. 39, 40. Can additional information/perspective on takes by tribal fisheries be supplied here?

P. 40. The cessation of operations of the gates at Red Bluff Diversion Dam is very good news. This indicates that water use operations can be altered for the benefit of green sturgeon provided there is strong science to support such actions. Here there clearly was (Lindley et al. 2007).

P. 41. Another nice example of consensus view on chief threat to sDPS sturgeon:  
“Although the sDPS green sturgeon is exposed to numerous threats within its range along the west coast of North America, the one threat that exceeds all others might be the fact that spawning is currently limited to one short reach of the mainstem Sacramento River, which represents a small portion of the species’ purported historical spawning habitat. It appears that sDPS green sturgeon prefer to spawn in the mainstem of large rivers, and these rivers have been dammed and variable water management practices do not favor the survival and recovery of this species.”

P. 46. I am concerned about over-reliance on historical benchmarks. These may no longer be relevant or feasible given how much the Central Valley Ecosystem has changed say during the past 100 years. Perhaps some additional specificity or bounds about feasible restoration targets would be useful.

P. 48. Recovery Criterion D6 seems vague. It would seem possible based on existing life history models to recommend a certain age structure. For instance, x-adult age-classes.

P. 49, 51. I understand the rationale for why Recovery Criteria statements TA, TD, and TE are rather vague, but I see no way of practically implementing this criterion as the threats exercise was so subjective given that this exercise cannot be replicated and has no quantitative basis (i.e., no precision or accuracy). Further, the level of research funding needed to address the long list of possible threats would be astronomical. This is an understandable dilemma for the GSRT and unfortunately I can’t think of alternative language here. The underlying problem again stems from a lack of a conceptual model for recovery.

P. 50. I think scientific/monitoring takes should be discussed in terms of the value they provide to recovery efforts. Worth including here are a couple statements justifying what type of scientific takes are permitted, their overall benefit to the recovery plan and a reference to a research protocol document should one exist for green sturgeon.

P. 52. (first line) Volcanoes are another catastrophic effect that comes to mind.  
This first paragraph is a very nice general articulation of challenges in species recovery within the Central Valley Ecosystem.

P. 55. This table should be cross-referenced with Appendix E and receive a legend.



P. 61. SRWA.A.1.1.3. “....fully seeding historic green sturgeon...” is an awkwardly constructed sentence.

P. 86. While some would obviously sympathize with goal “EOP.1.1 Promote a new paradigm in which man lives with nature instead of against it and where resource exploitation is not rewarded,” this is a nonspecific, philosophical, and controversial statement that should be changed or omitted. Other outreach objectives seemed spot on.

## **Conclusions and Recommendations according to Term of Reference**

**1. Do the basic elements of the draft recovery plan meet the minimum standards for recovery plans outlined in the NMFS Interim Recovery Guidance and mandates described in section 4(f)(1)(b) of ESA?**

### Conclusions

The Draft Recovery Plan (DRP) sufficiently addressed NMFS standards for an Interim Recovery Plan, but deliberately did not provide criteria for ESA delisting. Rather the premise of the DRP was that there is immediate jeopardy of a modified listing from Threatened to Endangered Status for the sDPS. Elements of the plan were designed to safeguard the sDPS from further decline. Based upon the status of the sDPS and existing threats this decision has a sound scientific basis. Goals and criteria were provided for interim goals of spawner abundance, effective population size, functioning spawning and early rearing habitats, and reduction in takes. Of these, spawning adult abundance and incidence of embryos and larvae were the only measurable criteria included.

The DRP provided a comprehensive review of species biology and life history pertinent to existing threats and recovery potential. The plan development team did a commendable job in placing historical and new scientific information into the context of threats and recovery of the sDPS.

Actions for recovery objectives pertaining to habit units within the Central Valley Ecosystem were provided that were quite specific to siting, environmental context, principal management/public entities, and proposed actions. Action items related to other habitat units, research planning, and monitoring were incomplete in the current DRP.

Interim goal milestones were presented in five-year horizons. The first phase would begin implementation of high priority actions to prevent further harm to the sDPS, develop a research plan including a conceptual model, continue monitoring, and develop outreach and funding streams. The following two 5-year phases were adaptive responses to developing research and monitoring capacities. No cost estimates were provided for recovery actions.

### Recommendations

A principal deficiency in the plan is that it lacks a conceptual model for status improvement or recovery of sDPS green sturgeon with which to frame assessment, scientific, and action priorities. A strong theme that emerges from the narrative of the DRP and Appendix C is the

priority to recovery reproductive function in multiple Central Valley rivers. The DRP would be much improved if it adopted this as a central objective and structured criteria, threats, and objectives on this interim goal rather than the large host of uncertain threats presented throughout the plan. Another central priority is reduction of takes, which could be an organizing theme for Recovery Objectives 3 and 4 (threats and actions outside of the Central Valley River ecosystem).

**2. Is there a logical and consistent flow between the goal, objectives, criteria, and actions?**

#### Conclusions

The DRP provides sufficient redundancy for the reader to know that a primary objective is to maintain and improve reproduction in the Sacramento River Watershed but this same priority is obscured by emphasizing uncertainty related to many potential threats and the need for additional research. The objectives are overly broad so that they do not efficiently link to criteria, threats and actions.

The ranking of threats exercise was unsuccessful, resulting in inconsistent priority assessment between the DRP's narrative and Table 1 (Appendix E). This resulted in ambiguity in priority between (1) the principal focus on restoration of spawning rivers iterated repeatedly in the text and (2) objectives, criteria, and threats used to develop the many action items listed in the plan (i.e., Appendix E).

#### Recommendations

The threats ranking exercise should be acknowledged as a preliminary exercise with important limitations due to its subjectivity and lack of repeatability. It should be de-emphasized throughout the DRP and not used to structure priority objectives. It detracts and is in conflict with the central priority to restore reproductive function within the Central Valley, which was well supported and articulated within the narrative.

Greater specification of objectives will improve flow between criteria and actions.

**3. Does the plan incorporate the best scientific information available?**

#### Conclusions

The GSRT is to be commended for its strong scholarship, inclusion of the most recent information, and comprehensive consideration of many direct and indirect threats to sDPS status and recovery. Sound scientific judgment and consensus was amply demonstrated in the narrative of the DRP.

#### Recommendations

None.

4. Does the plan address data gaps appropriately in relation to the formulation of recovery criteria and research actions (e.g. lack of information on contaminants to develop threats-based recovery criteria)?

#### Conclusions

There is a very strong emphasis to scientific uncertainty related to many potential threats. These were developed more thoroughly for threats within the Central Valley Ecosystem than those outside. Therefore, the DRP gives strong priority to future research planning but does so by de-emphasizing monitoring green sturgeon status and recovery. Monitoring is given priority but does not receive due critical treatment in terms of current and future monitoring platforms, feasibility, and power to detect trends.

#### Recommendations

The risk in over-emphasizing uncertainty and research is diffuse planning. Data gaps are more efficiently supported through frameworks of adaptive management for which monitoring and assessment are central. Highest priority (after actions related to immediate threats) should be given to sustaining, modifying, and implementing monitoring programs within the Central Valley Ecosystem.

5. Does the data provided by Mora et al. 2009 provide NMFS the best means for evaluating current and future habitat potential and the development of criteria to restore historical green sturgeon habitat within California's Central Valley?

#### Conclusions

Mora et al. (2009) employed a feasible approach for estimating potential habitats but depended on several assumptions that could not be fully supported, including that green sturgeon incidence data in the reference system was unbiased, that habitat selection between sDPS and nDPS was similar, and that a composite (multivariate) habitat variable was informative on habitat selection.

#### Recommendations

The Mora et al. (2009) approach is potentially useful in casting a very broad envelop over the Central Valley Ecosystem to develop survey designs for adult incidence or justify re-introduction trials. The approach cannot definitively identify current or past spawning rivers without ancillary data on incidence.

6. Does the plan provide clear guidance for the public, conservationists, managers, regulators, and others to act in a relevant manner over the next several decades to facilitate recovery of sDPS green sturgeon?

### Conclusions

The DRP provides quite specific action recommendations for the Sacramento River Watershed and San Francisco Bay Delta/Estuary Habitat Units. Appendix F specifies relevant management entities that will need to be engaged to successfully implement Recovery Strategy Objectives 1 and 2. Recovery Strategy Objectives 3 and 4 were not yet populated with specific actions or guidance narratives but in agreement with the DRP Narrative (as well as Appendix C), these habitat units are in general lower priority than habitat units in the Central Valley Ecosystem.

### Recommendations

Recovery Objectives 5 and 6 needed re-structuring and better specification to provide guidance to future planning activities pertinent to monitoring, assessment, and research. They are not well linked thematically to recovery objectives.

7. Recommendations for improvements?

### Recommendations

A stronger statement of the interim objective is needed - aimed at restoring reproductive function in the Sacramento River Watershed at the beginning of the DRP. The broad objectives are important but are in fact principles rather than objectives, which can lead directly to an implementation strategy.

The Recovery Plan should adopt an adaptive management framework, where strong priorities implicit in the plan's narrative are better structured around a conceptual model(s), monitoring, assessment, and research objectives.

New-found mixing between the two green sturgeon DPSs and mixing of green sturgeon with white sturgeon merits additional priority and guidance in criteria and actions related to takes. These considerations are given emphasis in the narrative of the DRP and Appendix C, but because threat objectives were not included under Recovery Strategy Objectives 3 and 4, guidance is currently lacking.

The strong emphasis on wetland and shoreline protection actions should be reconsidered because green sturgeon do not directly occur in wetland and littoral habitats.

Some additional discussion on genetic evidence and telemetry evidence for/against straying between the two DPSs would be helpful.

The issue of how flow and temperature regulation at Shasta Dam influences/maintains successful reproduction and early survival merits additional articulation and possible criteria and action items.

Given the high number of takes (1200-1500 sDPS sturgeons) additional documentation/analysis of bycatch and bycatch mortality should be included to justify take objectives.

Recovery Criterion D6 related to conservation of age/genetic structure seemed overly vague. It should be possible based on existing life history models to recommend a certain age structure. For instance, can't a criterion of so many adult age-classes be supported?

Scientific/monitoring takes should be discussed in terms of the value they provide to recovery efforts.

The objective "EOP.1.1 Promote a new paradigm in which man lives with nature instead of against it and where resource exploitation is not rewarded," should be reworded or removed.

## References

- Adams, P. B., and coauthors. 2007. Population status of North American green sturgeon, *Acipenser medirostris*. *Environmental Biology of Fishes* 79(3-4):339-356.
- ASMFC (Atlantic States Marine Fisheries Commission) 2007. Estimation of Atlantic Sturgeon Bycatch in Coastal Atlantic Commercial Fisheries of New England and the Mid-Atlantic. Special Report to the ASMFC Sturgeon Management Board. 95 p.
- Beamesderfer, R. C. P., M. L. Simpson, and G. J. Kopp. 2007. Use of life history information in a population model for Sacramento green sturgeon. *Environmental Biology of Fishes* 79(3-4):315-337.
- Brown, K. 2007. Evidence of spawning by green sturgeon, *Acipenser medirostris*, in the upper Sacramento River, California. *Environmental Biology of Fishes* 79(3-4):297-303.
- Clark, J. D., J. E. Dunn, and K. G. Smith. 1993. A multivariate model of female black bear habitat use for a geographic information-system. *Journal of Wildlife Management* 57(3):519-526.
- Coutant, C.C. 2004. A riparian hypothesis for successful reproduction of white sturgeon. *Reviews in Fisheries Science* 12: 23-74. Gross, M. R., and coauthors. 2002. Sturgeon conservation: insights from elasticity analysis. *Am. Fish. Soc. Sympos.* 28: 3-10.
- Heppell, S. S. 2007. Elasticity analysis of green sturgeon life history. *Environmental Biology of Fishes* 79(3-4):357-368.
- Heublein, J. C., J. T. Kelly, C. E. Crocker, A. P. Klimley, and S. T. Lindley. 2009. Migration of green sturgeon, *Acipenser medirostris*, in the Sacramento River. *Environmental Biology of Fishes* 84(3):245-258.
- Lindley, S. T., and coauthors. 2011. Electronic Tagging of Green Sturgeon Reveals Population Structure and Movement among Estuaries. *Transactions of the American Fisheries Society* 140(1):108-122.
- Lindley, S. T., and coauthors. 2008. Marine migration of North American green sturgeon. *Transactions of the American Fisheries Society* 137(1):182-194.
- NMFS. 2012. Endangered Species Act Section 7 Consultation Biological Opinion, Northeast Regional Office. 256 pp.
- NMFS. 2006. Interim Endangered and Threatened Species Recovery and Planning Guidance Version 1.3. 122 p.
- NMFS 1998. Final Recovery Plan for the Shortnose Sturgeon *Acipenser brevirostrum*. 129 p.

Schapaugh and Tyre 2011. Power Analysis for the Palld Sturgeon Population Assessment Program. University of Nebraska - Lincoln. Prepared for the U.S. Army Corps of Engineers. 42 p.

Stein, A. B., K. D. Friedland, and M. Sutherland. 2004. Atlantic sturgeon marine bycatch and mortality on the continental shelf of the northeast United States. *North American Journal of Fisheries Management* 24(1):171-183.

## Appendix 1

### Bibliography and materials provided for review

2006 (2010 Update) NMFS Interim Recovery Planning Guidance  
(<http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf>)

Endangered Species Act (<http://www.nmfs.noaa.gov/pr/pdfs/laws/esa.pdf>)

Mora, E.A., S.T. Lindley, D.L. Erickson, and A.P. Klimley. 2009. Do impassable dams and flow regulation constrain the distribution of green sturgeon in the Sacramento River, California? *Applied Ichthyology* 25:39-47.

NMFS. 2012. Internal Draft Recovery Plan for the Southern Distinct Population Segment of the Green Sturgeon (*Acipenser medirostris*). NMFS, Santa Rosa, CA.

Appendices to NMFS 2012 Draft Recovery Plan:

GS RP Appendix A - a list and description of threats

GS RP Appendix B - threat assessment methods

GS RP Appendix C - narrative of threats assessment results

GS RP Appendix D - threat assessment summary across the four habitat units (tabular)

GS RP Appendix E - threat assessment results for each habitat (tabular)

GS RP Appendix F - the Implementation Schedule (Excel)



## **Appendix 2. CIE Statement of Work.**

### **Attachment A: Statement of Work for Dr. David Secor**

#### **External Independent Peer Review by the Center for Independent Experts**

##### **Review of Draft Green Sturgeon Recovery Plan**

**Scope of Work and CIE Process:** The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Representative (COR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from [www.ciereviews.org](http://www.ciereviews.org).

**Project Description:** The Endangered Species Act (ESA) requires that NOAA's National Marine Fisheries Service (NMFS) develop and implement recovery plans for the conservation of threatened and endangered species. The southern Distinct Population Segment of North American green sturgeon was listed as a threatened species in 2006. It is a wide-ranging species, spawning in the Sacramento River in Central California, but spending the majority of its life in nearshore marine waters along the west coast of North America. Recovery plans serve as guidelines for achieving recovery goals by describing the steps that must be taken to improve the status of species and their habitat. Although recovery plans themselves are not regulatory documents, their primary purpose is to provide a conservation "road map" for federal and state agencies, local governments, non-governmental entities, private businesses, and stakeholders. The NMFS Recovery Plan for green sturgeon is expected to generate substantial interest from outside parties because it may contain recommendations involving water management in California's Central Valley. The draft recovery plan will include a large geographic area along the west coast of North America, with much of the focus on California's Central Valley, thus has the potential for wide-ranging implications. Stakeholder interest likely will lead to inquiries from elected representatives at the state and federal levels. The scope of work should focus on the principal elements required in a recovery plan. These principal elements have been defined in section 4(f)(1) of the federal Endangered Species Act (ESA) and sections 1.1 and 1.2 of the National Marine Fisheries Service Interim Recovery Planning Guidance (NMFS 2006). The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**.

**Requirements for CIE Reviewers:** Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have

working knowledge and recent experience in the application of fisheries management, conservation biology, restoration practices, water management, and conservation under the ESA. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein.

**Location of Peer Review:** Each CIE reviewer shall conduct an independent peer review as a desk review, therefore no travel is required.

**Statement of Tasks:** Each CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, and other pertinent information. Any changes to the SoW or ToRs must be made through the COR prior to the commencement of the peer review.

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

In addition to the recovery plan report, the NMFS Project Contact will make available background materials to the reviewers for the scope and context of the review. Some of these background documents include;

- o 2006 (2010 Update) NMFS Interim Recovery Planning Guidance (<http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf>)
- o Endangered Species Act (<http://www.nmfs.noaa.gov/pr/pdfs/laws/esa.pdf>)
- o Mora, E.A., S.T. Lindley, D.L. Erickson, and A.P. Klimley. 2009. Do impassable dams and flow regulation constrain the distribution of green sturgeon in the Sacramento River, California? *Applied Ichthyology* 25:39-47.

Desk Review: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COR and CIE Lead Coordinator.** The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements.

**Contract Deliverables - Independent CIE Peer Review Reports:** Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

**Specific Tasks for CIE Reviewers:** The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

- 1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
- 2) Conduct an independent peer review in accordance with the ToRs (**Annex 2**).
- 3) No later than **November 5, 2012**, each CIE reviewer shall submit an independent peer review report addressed to the “Center for Independent Experts,” and sent to Manoj Shrivani, CIE Lead Coordinator, via email to [shivlanim@bellsouth.net](mailto:shivlanim@bellsouth.net), and CIE Regional Coordinator David Die via email to [ddie@rsmas.miami.edu](mailto:ddie@rsmas.miami.edu). Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

**Schedule of Milestones and Deliverables:** CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

October 1, 2012	CIE sends reviewer contact information to the COR, who then sends this to the NMFS Project Contact
October 15, 2012	NMFS Project Contact sends the CIE Reviewers the draft plan and background documents
<b>October 16-31, 2012</b>	Each reviewer conducts an independent peer review as a desk review.
November 5, 2012	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
November 20, 2012	CIE submits the CIE independent peer review reports to the COR
November 27, 2012	The COR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

**Modifications to the Statement of Work:** Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COR within 10 working days after receipt of all required information of the decision on substitutions. The COR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

**Acceptance of Deliverables:** Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COR (William Michaels, via [William.Michaels@noaa.gov](mailto:William.Michaels@noaa.gov)).

**Applicable Performance Standards:** The contract is successfully completed when the COR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:

- (1) each CIE report shall be completed with the format and content in accordance with **Annex 1**,
- (2) each CIE report shall address each ToR as specified in **Annex 2**,
- (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

**Distribution of Approved Deliverables:** Upon acceptance by the COT, the CIE Lead Coordinator shall send via e-mail the final CIE reports in \*.PDF format to the COT. The COR will distribute the CIE reports to the NMFS Project Contact and Center Director.

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## **Annex 1: Format and Contents of CIE Independent Peer Review Report**

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.
2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.
3. The reviewer report shall include the following appendices:
  - Appendix 1: Bibliography of materials provided for review
  - Appendix 2: A copy of the CIE Statement of Work

## **Annex 2: Terms of Reference (ToRs)**

### **CIE Peer Review of Green Sturgeon Draft Recovery Plan**

The scope of work should focus on the principal elements required in a recovery plan. These principal elements have been defined in section 4(f)(1) of the federal Endangered Species Act (ESA) and sections 1.1 and 1.2 of the National Marine Fisheries Service Interim Recovery Planning Guidance (NMFS 2006).

Section 4(f)(1)(b) of ESA states “each plan must include, to the maximum extent practicable:

- a description of such site-specific management actions as may be necessary to achieve the plan’s goal for the conservation and survival of the species;
- objective, measurable criteria which, when met, would result in a determination...that the species be removed from the list; and,
- estimates of the time required and the cost to carry out those measures needed to achieve the plan’s goal and to achieve intermediate steps toward that goal.”

From section 1.1 of NMFS (2006), a recovery plan should:

- “Delineate those aspects of the species’ biology, life history, and threats that are pertinent to its endangerment and recovery;
- Outline and justify a strategy to achieve recovery;
- Identify the actions necessary to achieve recovery of the species; and
- Identify goals and criteria by which to measure the species’ achievement of recovery.”

#### **The terms of reference (ToRs) for this peer review:**

- 1.** Do the basic elements of the draft recovery plan meet the minimum standards for recovery plans outlined in the NMFS Interim Recovery Guidance and mandates described in section 4(f)(1)(b) of ESA?
- 2.** Is there a logical and consistent flow between the goal, objectives, criteria, and actions?
- 3.** Does the plan incorporate the best scientific information available?
- 4.** Does the plan address data gaps appropriately in relation to the formulation of recovery criteria and research actions (e.g. lack of information on contaminants to develop threats-based recovery criteria)?
- 5.** Does the data provided by Mora et al. 2009 provide NMFS the best means for evaluating current and future habitat potential and the development of criteria to restore historical green sturgeon habitat within California’s Central Valley.
- 6.** Does the plan provide clear guidance for the public, conservationists, managers, regulators, and others to act in a relevant manner over the next several decades to facilitate recovery of sDPS green sturgeon?
- 7.** Recommendations for improvements?